At programmed intervals, different containers and at least one sampling station are moved with respect to each other and samples are taken to fill the containers. The containers are filled so that there is no head space and minimum loss of volatile compounds. Preferably, the containers are standard sample bottles and the samples are drawn with a bladder pump to reduce loss of volatiles from the samples. The containers are preferably open to the atmosphere for no more than a few seconds and should not be open for more than ten minutes during the entire operation to avoid contamination.

From the above description, it can be understood that the sampler of this invention has several advantages, such as: (1) it is completely automatic; (2) it can draw samples without substantial release of volatile compounds; (3) it can draw samples at predetermined intervals without human intervention; (4) a single valve permits the flow into a sample container, overflow from the container during purging of air and collection of the sample liquid in the container; (5) the liquid enters the containers with little turbulence that otherwise would cause the volatile compounds to be released before the container is filled and sealed; and (6) the containers are completely filled with sample without head space.

SUMMARY OF THE DRAWINGS

The above noted and other features of the invention will be better understood from the following detailed description, in which:

FIG. **1** is a block diagram of a sampling device in accordance with the invention;

FIG. **2** is a simplified, partly broken away, fragmentary view of a sampling device in accordance with the invention;

FIG. **3** is a plan view of a portion of the sampling device of FIG. **1**;

FIG. **4** is a fragmentary front elevational view, partly sectioned of a filling station for sampling containers usable in the sampler of FIGS. **1–3**;

FIG. **5** is a side elevational view, partly sectioned, of a container usable in the embodiments of FIGS. **1–4**;

FIG. **6** is a top view of the container of FIG. **5**;

FIG. **7** is a fragmentary sectional view of the container taken through lines **7—7** of FIG. **6**;

FIG. **8** is a rear fragmentary, elevational view of the filling station of FIGS. **1–5**;

FIG. **9** is an elevational view of a needle assembly useful in the embodiments of FIGS. **1–8**;

FIG. **10** is an elevational view of a hollow needle useful in the embodiment of FIG. **9**;

FIG. **11** is a sectional view of a bladder pump useful in the preferred embodiment of sampler;

FIG. **12** is a block diagram illustrating the software steps utilized in sampling liquid in the embodiments of FIGS. **1–10**;

FIG. **13** is a block diagram of a portion of the program of FIG. **12**;

FIG. **14** is a block diagram of another portion of the program of FIG. **12**;

FIG. **15** is a block diagram of still another portion of the program of FIG. **12**;

FIG. **16** is a block diagram of a portion of the program of FIG. **15**;

FIG. **17** is a block diagram of another portion of the program of FIG. **15**; and

FIG. **18** is a block diagram of another portion of the program of FIG. **15**.

DETAILED DESCRIPTION

In FIG. **1**, there is shown a block diagram of a sampler system **10** having a control system **12**, one or more fill station drive motors **14**, a bladder pump **16**, a suction vacuum or negative pressure and positive-pressure source **17**, a driver **15** for the negative-pressure and positive-pressure source **17** and a distributor **18**. The pump **16** is adapted to communicate with a water source **20** to sample water therefrom. While a bladder pump **16** is used in the preferred embodiment, other types of pumps can be used such as for example a peristaltic pump. While the pump **16** may be any type of pump, it is advantageous for it to be a pump that draws liquid without such force as to dislodge volatile materials from the liquid.

In some embodiments, the source **17** of suction and positive pressure is not necessary since some pumps may operate only with pressure from a pressure outlet of a compressor. In the preferred embodiment, positive pressure and suction are alternately applied through a compressor from the suction and pressure outlets of the compressor. The compressor may be a model 014CDC20/12 compressor sold by Thomas Industries Inc., Power Air Division in Sheboygan, Wis., U.S.A. It may be connected to the bladder pump air inlet through a NVK300/3000 3–5 port solenoid valve such as manufactured by SMC Pneumatics, Inc., with the common outlet port connected to the bladder pump air inlet port and two inlet ports connected to the suction and pressure ports of the compressor. Of course, many other types of compressors and valves may be used.

To enable conventional battery operated compressors to provide the proper values of positive-pressure and negative-pressure, the driver **15** is pulsed by the control system **12** to proportion the actual time for application of suction and for positive pressure by the source **17** during a suction or pressure period. The driver, in response to programmed pulses from the control system **12** causes positive pressure or negative pressure to be applied to the pump **16** from the suction and positive pressure source **17** as pulses.

By proportioning the duty cycle of the pulses, the value of suction pressure can be reduced by a series of shorter width pulses or fewer pulses (lower duty cycle) or increased by wide or more numerous pulses (higher duty cycle) during the application of vacuum to the bladder pump. The same is true during the application of positive pressure. This enables conventional compressors, which generally have sufficient positive pressure but insufficient vacuum, to be conveniently used. The suction and positive pressure applied to the bladder pump are relatively free of pulsation because the tubing acts as an accummulator or reservoir.

The control system **12** can be preprogrammed to cause the pump **16** to pump samples of water from the water source **20** into containers within the distributor **18** and to control the fill station drive motor **14** to fill containers, which are usually standard sample bottles within the distributor **18**. The control system **12** controls this operation to automatically fill a series of containers with no air spaces remaining in the containers.

The control system **12** includes a central processing unit **22** with a typical display and/or printing unit shown at **24** and typical input units such as a keypad or electrical communication jack shown at **26**. The control system **12** is programmed and contains the necessary interfaces to coordinate the operation of the pump **16**, the distributor **18** and